Remarks

These remarks are submitted in response to the Non-Final Office Action of September 29, 2011. At the time of the Office Action, claims 1, 3, 7-11, 24, 25, 32-36 and 38-43 were pending. No new matter has been added.

I. Claim Rejections Under 35 U.S.C § 103

Claims 1, 3, 7-11, 24, 25 and 32-42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sengupta (US Patent 5,427,988) in view of Montgomery (Montgomery, Douglas. Design and Analysis of Experiments. New York:John Wiley & Sons, Inc, 1997).

Claim 1, as amended, recites that the at least two additional metal oxide materials are selected from a group consisting of Mg_2SiO_4, MgO, $CaTiO_3$, $MgZrSrTiO_6$, $MgTiO_3$, $MgAl_2O_4$, WO_3, $SnTiO_4$, $ZrTiO_4$, $CaSiO_3$, $CaSnO_3$, $CaWO_4$, $CaZrO_3$, $MgTa_2O_6$, $MgZrO_3$, MnO_2, PbO, Bi_2O_3 and La_2O_3. The Office Action relies upon the following portions of Sengupta:

> The materials within the scope of the present invention fall within the optimum characteristics outlined above. These materials are $Ba_{1-x} Sr_x TiO_3$ --MgO, wherein x is greater than 0.0 but less than or equal to 0.75. This formulation may be referred to as Barium Strontium Titanate and magnesia. The weight ratios of Barium Strontium Titanate (BSTO) to magnesia may range from 99% wt.-40% wt. BSTO to 1% wt.-60% wt. magnesia. A typical composition within the present invention may comprise 70% by weight BSTO (wherein x=0.35) and 30% by weight magnesia (MgO). This composition has a dielectric constant of 425.2, a loss tangent of 0.0006 and a tunability of 18.00 (applied electric field=20.3 KV/cm).
>
> Magnesia is used herein to adjust the electronic properties of BSTO. Magnesia at low doping levels (1-10% wt.) lowers the Curie temperature (temperature at which the peak dielectric constant occurs). At higher levels, it lowers the material's dielectric constant and loss to meet the requirements for various applications--for example, in the antenna arts. The electronic properties of the formulation herein can be adjusted for use in any discrete element phase shifter design, such as planar microstrip, wave guide geometries or for use in a parallel plate structure.
>
> It has been found that the electronic properties of BSTO magnesia are reproducible to within 2%. Hence, once a specific formulation of BSTO

magnesia is determined to be suitable for a specific purpose, the material can be accurately reproduced.

The preparation of BSTO magnesia may be accomplished by obtaining powders of Barium Titanate and Strontium Titanate. These powders are ball milled in a conventional manner in an organic solvent. This particular mixture is then air-dried and calcined at approximately 200 degrees below the sintering temperature for several hours. The resultant BSTO is then mixed with magnesia in the desired weight percentage and re-ball milled in an organic solvent with a binder. The final mixture is then air-dried, once again, and dry-pressed at approximately 7,000 p.s.i. The final samples are sintered in air. Proper electroding of the composite ceramics must be done. The samples were screen printed with a FERRO #3350 (Electronic Materials Division, Santa Barbara, Calif.) silver conductive ink. They were subsequently fired at 450.degree. for ten (10) minutes. The samples were then dipped in a bath of 2% silver (Ag), 62% tin (Sn) and 36% lead (Pb) solder with lead clips attached.

Table 1 sets forth the various properties of BSTO magnesia, wherein the formulation is represented by $Ba_{0.60}$ $Sr_{0.40}$ TiO_3 - magnesia.

TABLE 1

Magnesia Content (wt. %)	Density (g/cc)	% Porosity	% Absorption
1.0	5.00	10.70	1.94
5.0	5.300	3.97	0.63
10.0	5.192	3.36	0.55
30.0	4.689	4.27	0.81
60.0	3.940	2.56	0.751
80.0	3.5180	10.34	1.87

While particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention. For example, the invention may be modified to include ceramic-ceramic composites of BSTO and other low dielectric constant materials depending upon the particular requirements of the intended application. Among some of the other low dielectric constant materials which may be combined with BSTO are zirconia, alumina microballoons, alumina fibers or fabric, silicon dioxide and other low dielectric constant, low dielectric loss oxides. (Alumina microballoons are hollow spheres of approximately 1-5 microns in diameter and are already sintered components (BSTO/ceramic)--the electronic properties of a composite employing alumina microballoons will most likely differ from composites employing alumina powder. Alumina

> fibers or fabric, when employed in the composite within the scope of the present invention, may possess electronic properties different from composites which employ alumina powder. This is due to the fact that this form of alumina is most likely to be in sintered form; and the fibers or fabric alumina produce different connectivity between the BSTO particles.)

The Office Action at page 2 characterizes these cited portions of Sengupta as a layer of tunable material with two metal oxides such as MgO and SiO_2. However, even if this characterization were correct, the cited portions of Sengupta still do not render obvious the features of amended claim 1 of the at least two additional metal oxide materials being selected from a group consisting of Mg_2SiO_4, MgO, $CaTiO_3$, $MgZrSrTiO_6$, $MgTiO_3$, $MgAl_2O_4$, WO_3, $SnTiO_4$, $ZrTiO_4$, $CaSiO_3$, $CaSnO_3$, $CaWO_4$, $CaZrO_3$, $MgTa_2O_6$, $MgZrO_3$, MnO_2, PbO, Bi_2O_3 and La_2O_3. The Office Action relies upon Montgomery for its purported description of a "one-factor-at-a-time" methodology. Montgomery also does not describe the aforementioned features of claim 1. Hence, claim 1 is allowable. Claims 3, 7-11, 24 and 25 depend from claim 1 and are allowable at least by virtue of their dependency.

Claim 32, as amended, recites that the at least two additional metal oxide materials do not include MgO. As explained above, the Office Action at page 2 characterizes these cited portions of Sengupta as a layer of tunable material with two metal oxides such as MgO and SiO_2. The cited portions of Sengupta do not render the aforementioned features obvious. The Office Action relies upon Montgomery for its purported description of a "one-factor-at-a-time" methodology. Montgomery also does not describe the aforementioned features of claim 32. Hence, claim 32 is allowable. Claims 33-40 depend from claim 32 and are allowable at least by virtue of their dependency.

Claim 41, as amended, recites mixing particles of at least one electronically tunable dielectric material and particles of at least two additional metal oxide materials that are Mg-free compounds. As explained above, the Office Action at page 2 characterizes these cited portions of Sengupta as a layer of tunable material with two metal oxides such as MgO and SiO_2. The cited portions of Sengupta do not render the aforementioned features obvious. The Office

Action relies upon Montgomery for its purported description of a "one-factor-at-a-time" methodology. Montgomery also does not describe the aforementioned features of claim 41. Hence, claim 41 is allowable. Claims 42-43 depend from claim 41 and are allowable at least by virtue of their dependency.

II. <u>Conclusion</u>

This application is in condition for allowance, which action is respectfully requested. It is respectfully requested that the Examiner call the undersigned if clarification is needed on any matter within this Amendment, or if the Examiner believes a telephone interview would expedite the prosecution of the subject application to completion. Please charge any deficiencies or credit any overpayment to Deposit Account No. 50-5199.

Respectfully submitted,

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